SOIL SURVEY OF THE BIGFLATS AREA, NEW YORK.

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LOCATION AND BOUNDARIES OF THE AREA.

The area surveyed, which is coextensive with the Elmira topographical sheet of the U. S. Geological Survey, is located in the southern part of New York State, lying principally in the counties of Chemung

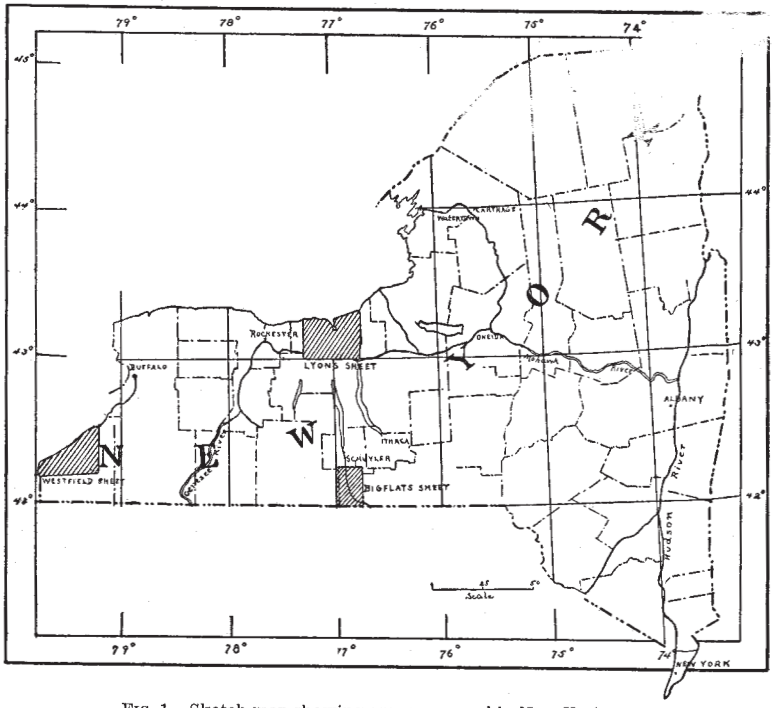

FIG. 1.—Sketch map showing areas surveyed in New York.

and Steuben and including along the southern border a small part of Bradford County, Pa. It comprises the greater part of the Bigflats tobacco district, well known for the production of a superior quality of leaf. The area contains 143,040 acres, or about 223 square miles. (See fig. 1.)

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The Seneca Indians, who occupied the Chemung Valley during the Revolutionary period, had learned some agriculture from the French,

and when their camps were raided and destroyed by General Sullivan in 1779 there were found in the vicinity of Elmira large fields devoted to the cultivation of corn, beans, turnips, and other vegetables. Upon the destruction of their stronghold the Indians were driven back into the wilderness, leaving the valley open to settlement by the whites.

Little settlement took place, however, until 1783, when the New York State legislature passed laws very favorable to actual settlers and those holding military warrants for land. In 1788 a number of families from Orange County, N. Y., Northampton County, Pa., and Sussex County, N. J., took advantage of these opportunities and entered the Chemung Valley, building houses, clearing lands, and planting the first fields of corn.

The soils in their virgin state were fertile, 50 bushels of wheat to an acre being no uncommon yield. The development was rapid, as shown in the Chronicles, 1803, which state that from 40,000 to 50,000 bushels of wheat, besides a number of fat cattle, were being annually sent down the Susquehanna River to market. Several thousand pounds of maple sugar were made yearly. Much attention was also paid to fruit growing. Many peach and apple orchards were being set out, while some had already begun to fruit.

In 1832 the Chemung Canal was excavated. This opened a cheap way to market for all produce of the area, and, while especially favorable to the lumber interests, gave a new impetus to agriculture, which had already made marked advancement. The hills were heavily forested with oak, maple, walnut, pine, and hemlock, and as lumber was in great demand roads were opened and a large number of logs were cut and sent down the canal. As the hills were deforested the lands were gradually cleared and farmed. Thus the uplands were rapidly brought under cultivation.

The completion of the Erie Railroad in 1851, giving cheap and rapid communication with the important inland and seaboard cities, gave a second impetus to the growth of agriculture. From this time on there has been a gradual increase of the agricultural interests until at present little land remains, except the steep and impassable hillsides, that has not been turned to the plow.

To-day the area is one of the most prosperous farming sections in the State. Comfortable houses, large barns, and highly improved farms, the most striking evidence of prosperity, dot the area. The population of the valley is somewhat over 40,000.

The flourishing condition of the area is due in a great measure to diversified farming and not to any one particular crop, though wheat played an important rôle, especially in the early development. Corn, oats, rye, buckwheat, beans, potatoes, and other crops all have had a share in the building up of the region.

Within a comparatively short time tobacco growing has come into prominence. Much improvement has been made in the methods of cultivation and harvesting of this crop, and it is now the most important product of the area, which has become the center of one of the best leaf-producing sections of the State.

Dairying and stock and poultry raising also form an important part of the husbandry, large quantities of milk, butter, and eggs, with some fat stock, being annually sent to market from this area.

CLIMATE.

The following table, compiled from records of the Weather Bureau office at Elmira, shows the normal temperature and rainfall of the Chemung Valley. There are no other stations in the area surveyed, and it is impossible to give any data that will show the climatic differences which undoubtedly exist between the valley and the hills.

Normal monthly and annual temperature and precipitation for Bigflats area.

Month.	Elmira.		Month.	Elmira.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F.	*Inches.*		°F.	*Inches.*
January	24.8	2.17	August	69.2	3.40
February	26.3	1.71	September	62.6	2.80
March	33.6	2.23	October	50.4	2.93
April	46.1	2.91	November	31.1	2.26
May	58.4	4.30	December	29.4	2.27
June	68.4	4.03	Annual	48.3	34.04
July	72.0	3.03			

PHYSIOGRAPHY AND GEOLOGY.

The topography and geology of the Bigflats area is comparatively simple. The greater part consists of rounded hills with a maximum elevation of about 1,900 feet, composed of Paleozoic shale and sandstone, with a general dip to the south. These rocks are all of the Chemung group, excepting a small body in the northern part of the area, where the Portage enters and is exposed in several places.

The Chemung Valley, which has an average width of 2 miles, enters the area about midway of its western boundary, extends in a northeastern direction to Horseheads and thence south through Elmira, leaving the area a little above the southeastern corner. This valley and its principal tributaries—the valleys along Seeley, Newtown, and Catherine creeks, the valley extending along the river west of Elmira, and the land along Fall Brook—embrace all the comparatively level and best farming land of the area. The soils here are derived from

the wash from the hills, from glacial till and detritus, or from a combination of the two.

The sediments which formed the shale and sandstones constituting the hills and underlying the valleys in this region were laid down in comparatively shallow water either by tide or wave action, as is shown by the frequent cross-bedding of the strata. This took place in the Devonian era of Paleozoic time, when the greater portion of the American continent was under water. An elevation of the land followed, leaving a large section of country at a point much higher than it at present occupies. At this particular time the drainage of the area surveyed is supposed to have been toward the north.

A change in climatic conditions caused a great accumulation of ice in the northern part of the sphere. The ice gradually moved southward, enveloping a great part of the Temperate Zone, its southern boundary lying to the south of the State of New York. The movement of this vast ice sheet was quite uniform, but the advance and acquisition of territory along the southern border was periodical and subject to seasonal changes, being greater in the winter than in the summer. This advance of the ice was accompanied with very great erosion, large quantities of soil and rock being gouged from the surface, picked up, and carried away. From the front of the glacier water was continually given off, and the old drainage channels to the north being filled with ice, the streams were forced to find new outlets to the south.

A reversal of the climatic conditions that caused the accumulation and advance of the ice sheet forced it to retreat. As it did so, large quantities of detritus were left in its path. In the Chemung Valley, where the glacier was perhaps a thousand feet thick, the greatest accumulations are found. These occur over a generally uneven, low, rolling or terraced surface. In the vicinity of Horseheads some of these forms are well developed. To the east and north are prominent terraces, while to the west, between Horseheads and Bigflats, the low hills, undoubtedly formed of material left by the retreating ice, can be plainly seen. The melting of large quantities of ice as the retreat was in progress produced enormous volumes of water, which drained down steep inclines and eroded out deep channels. At this period a general subsidence of the continent, in what is known as the Champlain epoch, took place. This perhaps augmented the melting of the ice, but in any event the rivers, deprived of their fall, were unable to carry off all the coarse material given off by the ice and much was necessarily deposited.[a] The subsidence was in turn followed by the terrace epoch of gradual reelevation to the present point. During this period much

[a] A well in the valley near Horseheads is said to have encountered glacial till to a depth of about 90 feet.

erosion has taken place and all the glacial drift that remains in the hills at the present time is an occasional transported bowlder. The storm waters have greatly washed the hills and in many places cut steep gullies, down which large quantities of soil are annually carried and deposited over the glacial till of the lowlands in the form of cone or fan shaped deltas. In the valley the river and large creeks are slowly cutting and forming terraces in the material which was deposited during the Champlain period.

SOILS.

There are two distinct classes of soils in the area surveyed—transported or sedimentary soils and sedentary or residual soils. The latter class is confined to the hills, which cover the greater part of the area, and is the result of the weathering and disintegrating in place of the Paleozoic rocks of the Chemung period. The former embraces glacial deposits partially modified by water, the washings from the surrounding shale hills, and the sediment resulting from the blending of glacial material with that from the shale hills carried down and deposited by the Chemung River.

The following table shows the extent of each of the seven types mapped, and the proportion which each bears to the total area:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Hagerstown shale loam	108,800	76.1	Meadow	1,920	1.3
Miami gravelly loam	15,680	11.0	Peat	576	.4
Elmira shale loam	8,512	6.0	Total	143,040	.....
Elmira fine sandy loam	5,632	3.9			
Elmira silt loam	1,920	1.3			

MIAMI GRAVELLY LOAM.

The Miami gravelly loam consists of a light-brown sandy loam, averaging about 16 inches in depth and containing various amounts of stone and gravel up to 60 per cent. It is a loose, friable soil, and when the stone and gravel content is not too high it is fairly easy to till. Where the stones occur in such quantities as to seriously interfere with cultivation large numbers have been picked up and hauled from the fields. The gravel is usually well rounded, having the subangular form, obtained by glacial and water action, to a greater extent than that found in any other of the soil types of the area. (See Pl. I, fig. 1.) The fragments are mostly shale, but the great quantity of transported rock—red and white sandstone, quartz, granite, etc.—is a striking characteristic of the type. The subsoil is of a yellowish color and

contains a less amount of loam and a higher percentage of gravel. Underlying the gravel occasional sand beds are found.

A slight variation from the general type occupies some of the low rolling hills between Horseheads and Bigflats. In this location the gravel is not so plentiful, and the interstitial material varies from a sandy loam to a fine sandy loam.

The Miami gravelly loam occupies about 50 per cent of the Chemung Valley, occurring in the form of low, rolling hills, gently sloping plains, terraces, and isolated glacial dumps, or as the capping of small, rounded knolls or benches situated at the base of the main hills, though generally separated from the hills by slight depressions.

The soil has been formed to a great extent from glacial deposits or the sediments left by overflows. These in turn have been partially reworked by water and mixed to a great extent with shale fragments. Years of weathering, with a slow accumulation of humus, have resulted in the present loose, porous, well-drained soil.

Most of the ordinary farm crops, including tobacco, rye, wheat, corn, buckwheat, potatoes, and beans, are raised on this soil. Tobacco commands special attention, and where well fertilized with stable manure yields of from 1,300 to 2,000 pounds per acre are obtained, the average being probably not far from 1,500 pounds. The leaf is of a superior quality, light in color, of fine flavor, and generally considered the best produced in the area.

The following table shows the texture of typical samples of the soil and subsoil of this type:

Mechanical analyses of Miami gravelly loam.

[Fine earth.]

No.	Locality.	Description.	Organic matter.[a]	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
6775	½ mile W. of Horseheads.	Light-brown sandy loam, 0 to 18 inches.	1.88	15.52	25.32	7.68	4.66	8.56	27.46	10.02
6772	¼ mile W. of Bigflats.	Gravelly loam, 0 to 20 inches.	3.36	1.08	5.16	5.24	14.32	19.96	43.56	10.18
6774	3⅛ S. 3 miles E. of Elmira.	Sandy loam, 0 to 12 inches.	3.62	3.00	6.52	4.64	9.62	24.00	42.14	10.84
6773	Subsoil of 6772.....	Gravelly loam, 20 to 40 inches.	1.42	1.06	6.50	6.54	13.36	21.84	36.82	13.04

[a] The "organic matter" in this and subsequent tables was determined by a wet combustion of a sample of the soil with chromic acid and multiplying the carbon dioxide obtained by the conventional factor 0.471 proposed by Wolf, Van Bemmelin, and others.

ELMIRA FINE SANDY LOAM.

The Elmira fine sandy loam is a light-brown fine sandy loam, varying in depth from a few inches to more than 3 feet. The average of a large number of borings gives a depth of 17 inches of fine sandy loam underlain by a more sandy subsoil, lighter in color and becoming coarser in depth, or by silt. From this typical section there are slight variations, due to the action of the river, which here and there has deposited sand or silt over small areas. In the borings local differences observed were occasional streaks of sand in the fine sandy loam or silt of surface or subsoil. Considering the manner in which this soil has been laid down and the frequent overflows to which it has been subjected, these variations are of less extent than might reasonably have been expected; in fact, such areas were too few and too small to warrant classification under a separate type name.

The areas occupied by the Elmira fine sandy loam cover the major part of the bottom lands and occasional terraces, locally called "abutments," along Chemung River and Newtown Creek. (See Pl. II.) This type constitutes the alluvial lands formed by the blending of the washings from the shale hills with those from the glacial deposits. It is well drained, light, and friable, and the easiest soil to farm in the area.

Where the lands are subject to frequent overflow and are farmed to crops requiring cultivation, it is found advantageous after harvesting to put the lands in sod by sowing a hardy crop, like rye. This protects the soil from washing and checks the velocity of the flood water, which often deposits an inch or more of fertile sediment. On the other hand, where the soil is low and unprotected great quantities of earth are often removed by the flood waters, which scour out wide gullies often more than a foot in depth.

When the extent, natural fertility, and general productiveness of this soil are considered, it stands first in importance among the soils of the area, and in value per acre is only exceeded by the Peat. Large crops of corn, wheat, oats, rye, buckwheat, potatoes, clover, timothy, and tobacco are grown. A few small apple and pear orchards in the vicinity of homes were said to fruit well.

On this soil the tobacco attains its greatest height and size, but the leaf is coarser and not as light colored as that raised on the Miami gravelly loam or the Elmira shale loam, and on this account it does not command as high a price. Exceptions to this rule are the sandy variations of the type, covering very small areas, upon which the tobacco has a light color and a thin leaf. In one of these places, protected by a levee from overflow, one-half acre of Sumatra tobacco was grown beneath shade in the season of 1901 with results so satisfactory that this year about 5 acres have been tented.

The appended table shows the texture of typical samples of the soil and subsoil of this type.

Mechanical analyses of Elmira fine sandy loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Sil., 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
6764	¾ mile SE. of Elmira.	Sandy loam, 0 to 40 inches.	1.44	0.18	0.54	1.04	19.26	43.06	28.76	7.16
6767	2 miles S. of Big-flats station.	Fine sandy loam, 0 to 20 inches.	2.51	.12	.38	.28	9.90	36.30	43.10	9.88
6765	1 mile SW. of Big-flats.	Brown sandy loam, 0 to 14 inches.	1.75	.16	.90	.74	6.02	30.44	48.26	12.60
6769	3 miles S., 2¼ E. of Elmira.	Silty loam, 0 to 30 inches.	1.53	.00	.28	.26	2.58	15.34	62.48	18.24
6768	Subsoil of 6767.....	Sand, 20 to 40 inches.	.68	.04	.28	2.18	18.72	34.00	36.52	8.26
6766	Subsoil of 6765.....	Fine sandy loam, 14 to 40 inches.	.31	.00	.30	.40	4.10	27.08	49.40	18.38
6770	Subsoil of 6769.....	Yellow silt loam, 30 to 40 inches.	.60	.00	.10	.34	.98	10.58	67.04	20.28

ELMIRA SHALE LOAM.

The soil of the Elmira shale loam consists of a light-gray loam, 10 or more inches in depth, containing a large percentage of silt and fine sand. It is mellow, loamy, and easily cultivated. The subsoil, which is found at from 10 to 24 inches below the surface, is much the same in texture and slightly lighter in color, having in certain localities a yellowish cast. The difference in color is in a certain measure due to the presence of a less amount of organic matter. It contains angular shale fragments or bowlders, which occur in such great quantities that it is practically impossible to find a place where an auger hole can be put down for more than 3 feet without interruption.

A stony phase of the type, indicated by gravel symbols on the map, consists of a light-colored loam with a depth of 8 or 9 inches, intermixed with angular shale fragments, varying from 30 to 60 per cent of the whole mass. The interstitial material here, as well as in the typical soil, varies and depends upon the location. It may be either a sandy loam or silt, the coarser material being confined to the center of the flood plain, and the finer to the outer borders. The subsoil of the stony phase contains the same amount of shale as the soil, is much the same in texture or slightly heavier, lighter in color, and is characterized in certain localities by a decided yellowish cast of color.

On a number of farms of the gravelly phase considerable time is spent in picking off the large stones, and in this way much rock is annually removed. In the area lying about 3 miles west of Horseheads the stony phase is well developed and is locally called "Sing Sing" gravel.

The Elmira shale loam is formed from the washings from the Hagerstown shale loam, and occupies the valley on both sides of Seeley Creek, occurring also along Sing Sing and Newtown and other smaller creeks. Where the creeks have deep-cut canyons with slight fall the soil is deposited in the form of great sloping plains, but where steep channels prevail and the streams are swift large quantities of material are carried down to the valley to be deposited, as the creeks adjust themselves to the more gentle slopes, in the form of fan or cone deltas. It is in the latter areas that the stony phase is found. The stone consists of angular or slightly worn shale fragments. Exceptions, however, were noted where well-rounded bowlders of quartz, sandstone, and other rock had been picked up from the glacial dumps and deposited with the other material.

Besides tobacco, all of the general farm crops are grown, but to obtain the best yields it is necessary to give the soil a liberal application of manure. Especially is this true of the tobacco lands, which require heavy manuring annually. The cultivation of tobacco is attended with good results, even on land that would ordinarily be considered a veritable rock pile. The plants grow well and though not as many pounds per acre are produced as on the Elmira fine sandy loam, the leaf is finer, possesses a better color, and commands a higher price.

The following table shows the texture of samples of this soil as determined by mechanical analyses:

Mechanical analyses of Elmira shale loam.

[Fine earth.]

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
6783	¾ mile NE. of Seeley Creek.	Light-brown loam, 0 to 12 inches.	3.07	0.46	1.44	0.80	3.92	32.12	49.42	11.10
6784	1½ miles E. of Southport.	Light gray-colored loam, 0 to 24 inches.	1.99	1.70	3.60	1.70	3.10	19.54	53.88	16.48
6782	2 miles NE. of Horseheads.	Loam, 0 to 8 inches..	3.23	8.98	6.90	2.40	3.36	9.10	48.68	20.30

HAGERSTOWN SHALE LOAM.

The Hagerstown shale loam is a light-gray or ash-colored friable loam 6 to 8 inches in depth, interspersed with a greater or less amount of angular shale fragments, sometimes reaching as much as 60 per

cent of the whole mass. The texture of the interstitial material varies slightly with the variations in the character of the rock from which the soil is derived. Where fine-grained shales occur, such as prevail over the greater part of the hills, a silty loam is the resulting material, but where the shaly sandstones are found the soil is a fine sandy loam. The subsoil consists of a lighter colored loam with a yellowish cast, occasionally mottled or streaked with dark gray or blue. It contains a higher percentage of loose, angular shale fragments than the soil, and eventually grades into shale in place.

Excepting a few small and unimportant areas, the type occupies all the hill lands of the Elmira sheet. These hills, ranging in elevation from 900 to 1,900 feet above the sea, cover more than 75 per cent of the area surveyed. On account of the many and varied positions in which the soil is found—on steep and on gentle slopes, in exposed and in protected localities—the depth of soil varies greatly. There are places where the rock outcrops or comes quite near the surface, so that the plow rides on a ledge of shale the entire length of the field. In other places the soil has accumulated to a depth of 3 feet or more. The proportion of loose rock in the soil also depends on the location. Where disintegration is in advance of erosion the greatest amount of soil is found and, vice versa, where the washing is most active the largest amount of rock fragments occur. In many places they exist in such great quantities as to render cultivation difficult, and many have been picked off the fields and thrown in large heaps or piled up in fences, to which latter purpose they are well adapted on account of their flat surfaces. On a few of the low, rounded hills northeast and northwest of Horseheads a slightly different phase of this type occurs, one of the most striking characteristics of which is the small number of stones present. On these hills the soil has about the average depth for the type, but is underlain by a heavier subsoil.

In a number of places on the hills, even on some of the highest points, occasional rounded bowlders consisting of red and white sandstones, quartz, and granite are observed. As there are no local rocks of these varieties the conclusion is that they have probably been transported by glaciers.

On the shale hills in many places the roots of forest trees seem to have been unable to penetrate the soil, but spread out in the shape of broad fans over the surface. In clearing the land large numbers of these stumps have been made into fences, where they have stood for more than forty years and are yet apparently good for many more.

Originally the hills supported a heavy forest of pine, but this has all been removed and all that remains is a small amount of second-growth pine, hemlock, maple, hickory, chestnut, and oak. Little attempt is made to encourage the growth of forests. Trees even less than a foot in diameter are cut to supply the local lumber demand, and

it is now only a question of a short time when the few remaining trees will be destroyed. In the forested state the hills are in a great measure protected from washing, but when cleared and turned to the plow large quantities of soil and plant food are annually carried away. When first farmed, good crops were harvested and prosperity prevailed throughout the area, as is generally the case with virgin soil, but by years of cultivation the lands have been in a great measure exhausted of available plant food. This is not due so much to the amount removed by cropping as to that which is continually removed by washing and leaching. Another important factor causing a greater depletion of the hill farms than of those of the valley is the fact that they are held in larger tracts and not enough manure is produced to cover more than a small part of the cultivated area, while at the same time their location, making hauling difficult as well as expensive, has prevented the bringing in of manure and fertilizers from outside sources. Tobacco culture has also played its part in impoverishing many of the farms. The few acres devoted to this crop take the greater part of the barnyard refuse to the deprivation of the rest of the land. As the result of these and various other causes the greater part of the hill farms are now in a state where their working is attended with very little profit, and a number of abandoned farms may be seen.

On this soil are raised, as in the lowlands, all the ordinary farm crops, including beans and potatoes, the latter being of a superior quality and keeping exceptionally well.

The following table gives the mechanical analyses of typical samples of this soil:

Mechanical analyses of Hagerstown shale loam.

[Fine earth.]

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
6785	1½ miles W., ½ N. of Post Creek.	Loam containing silt, 0 to 5 inches..	2.75	4.40	4.26	1.28	2.20	19.12	51.36	17.16
6789	2 miles N. of Sullivanville.	Silty loam, 0 to 7 inches.	2.87	2.02	3.30	1.98	4.10	13.08	53.84	21.36
6787	2½ miles NE. of Elmira.	Silty loam, 0 to 10 inches.	1.73	2.48	3.06	1.40	1.76	9.12	59.58	22.50
6786	Subsoil of 6785.....	Loam containing silt, 5 to 18 inches.	.95	6.64	5.20	1.86	3.40	18.90	46.90	17.06
6790	Subsoil of 6789.....	Silty loam, 7 to 18 inches.	.40	1.10	2.62	1.56	3.32	15.96	56.20	19.08
6788	Subsoil of 6787.....	Silty loam, 10 to 24 inches.	.32	1.78	3.02	1.64	2.70	5.24	57.42	28.12

ELMIRA SILT LOAM.

The Elmira silt loam consists of silt loam of a very uniform texture, 6 to 8 inches in depth, and for the most part light gray or ashy in color. This color is materially darkened where the soil is heavily manured or kept in pasture. Under certain conditions of moisture the soil is difficult to plow, forming clods, but taken at the right time it breaks up well and becomes in good tilth. The subsoil, which is at least 40 inches in depth, consists of a dark-yellowish loam, streaked with gray and blue. It is much heavier than the surface soil and offers considerable resistance to the passage of the ground water. This is rather a serious objection, making the land cold, moist, and late, retarding both the planting and the harvesting of crops. This untoward condition has been successfully met by the use of tile drains.

The soil has been formed by the weathering of fine washings from the shale hills brought down by the flooded mountain streams and deposited by slowly moving water. It is either farmed to cultivated crops or used for pasture. All the crops common to the region, such as corn, oats, wheat, rye, buckwheat, and tobacco, are grown. The culture of the last named is most successful on the drained land and on the sandy spots found adjacent to creeks. The tobacco raised, especially on the underdrained soil, attains a good height and yields about as well as on any of the soils of the area. The leaf is large, thin, and suitable for wrapper, and in quality compares favorably with the best produced in the area. The best-colored leaves are raised on the sandy spots. The sandy soil generally matures the crop slightly in advance of the heavier soil.

To produce large crops on the Elmira silt loam it is found necessary to make liberal applications of manure. This is especially true where tobacco is the crop to be grown. As much as one or even two carloads of stable manure per acre are annually applied to the tobacco fields.

The table on the following page shows the texture of typical samples of the soil and subsoil of this type.

Mechanical analyses of Elmira silt loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*
6780	1½ miles NE. of Bigflats Station.	Fine sandy loam, 0 to 10 inches.	3.27	0.16	1.02	1.46	3.90	30.06	50.00	12.86
6776	¾ mile W. of D., L. and W. Station, Bigflats.	Light gray silty loam, 0 to 8 inches.	2.60	.20	.60	.40	.86	12.64	67.32	17.46
6778	1 mile NE. of East Corning.	Silt loam, 0 to 10 inches.	2.62	1.46	3.98	1.88	3.42	3.14	50.84	35.12
6781	Subsoil of 6780.....	Fine sandy loam, 10 to 40 inches.	.27	.24	.48	.42	1.22	25.44	59.96	11.48
6777	Subsoil of 6776.....	Heavy silt loam, 8 to 40 inches.	.34	.00	1.30	.70	.66	12.34	65.72	18.60
6779	Subsoil of 6778.....	Heavy silty or clay loam, 10 to 40 inches.	.42	.58	1.56	.62	.94	7.82	62.02	25.52

PEAT.

The Peat is dark brown or almost black in color and consists of vegetable matter in various stages of decay. It varies in depth according to location, the deposit being deepest in the center of the areas, where it occasionally has a thickness of 8 or more feet. It is always loose, incoherent, and very easy to till.

All the areas of this type are found in the valley and lie to the north of Elmira. They occur for the most part as small, irregular patches and streaks in depressions where the water table is either at the surface or within a short distance of it. Originally these spots, with a few exceptions, were covered by small, shallow ponds or lakes fed by springs and favoring the growth of tules, reeds, and other water-loving plants. Here the decaying plant remains slowly accumulated from year to year until the ponds were filled and in places covered over with deposits more than a foot in depth. Several ponds may be seen at present in part or completely overgrown with swamp vegetation, and it is only a question of time, if the growth is not interrupted, when they too will be converted into peat areas.

Before the Peat can be cropped drainage is generally found necessary. This is done by a system of underground tile or open ditches from 2 to 4 feet in depth, which lower the water table sufficiently to permit thorough cultivation. The cuts or ditches along the boundary lines show the Peat to be underlain with blue silty clay. On account of the boggy nature of this soil, it is found necessary to put supporting shoes on the plow horses. These are made of flat pieces of

iron or steel about 12 inches in diameter, and are attached to the foot by means of two clamps that lock over the front of the hoof. It is said the horses have some difficulty at first in using these shoes, but soon become accustomed to them. The fact that such shoes are necessary gives an idea of the miry character of this soil type.

To a limited extent the peat has been dried and used in the stables and barnyards as an absorbent and afterwards applied with good results to tobacco lands.

Celery is the principal crop grown on Peat, to the cultivation of which it is peculiarly adapted, large crops being harvested annually. (See Pl. I, Fig. 2.) Cabbage, onions, and some farm crops are also grown and give large yields, but as their cultivation is not confined to the muck areas and is not as profitable, these products generally give way to celery.

MEADOW.

This term is used to designate lands too moist for cultivation without drainage, occurring in small narrow areas adjacent to swamps, springs, and water courses. Such areas are generally covered with a growth of grass and used mostly for pasturage. The texture of the soil varies according to location. On the hills adjacent to springs and swamp depressions it is for the most part a dark-colored loam about 8 inches in depth, underlain with a heavy subsoil. Near the streams the texture is lighter, containing more silt and sand. In all of these areas shale fragments are occasionally found in the surface soil and to a greater extent in the subsoil. In the lowland or valley the soil consists of a silty clay 11 inches or more in depth underlain with blue sand.

AGRICULTURAL METHODS.

In the Bigflats area much care is exercised in the preparation of the soils for planting. They are all thoroughly plowed, an average depth of 6 inches being deemed necessary for all the ordinary crops, which include corn, wheat, oats, rye, buckwheat, timothy, potatoes, and clover, while special care is given in preparing the soil for tobacco and celery.

On some of the most successful tobacco farms the land is plowed in the fall and seeded to rye or wheat, which is allowed to grow until about May of the following year, when it is turned under for green manure. Where the fields are subject to overflow, this winter growth, in addition to fertilization, gives considerable protection to the surface, keeping it from washing by checking the velocity of the flood waters and causing the deposition of much alluvium, which also enriches the soil. The tobacco plants are raised in hothouses or beds and set out in fields that have been thoroughly plowed, harrowed, and rolled. Mechanical planters, drawn by horses and constructed to mark the row and cover and water the plants at one operation, greatly facilitate

transplanting. From one-half acre to 1½ acres can be set in this way in one day by a man and two boys. (See fig. 2.) As soon as the plants take root and begin to grow they are cultivated, and cultivation is repeated as often as necessary until the crop matures. When the tobacco begins to bud, the button is pinched out, which forces the energy into the leaves and stalk buds. The latter rapidly develop into shoots or suckers, all but one or two of which are removed. This number is sufficient to keep the plant growing and the leaves in good condition. As the plants mature they are cut and hung in sheds, where they remain until thoroughly dry. They are then taken down in damp weather and the leaves stripped off and tied in bundles or packed in boxes ready to be sold. The price varies from 5 cents to 18 cents per pound. In most cases the sorting is left to the buyer, but occasionally it is done by the farmer.

FIG. 2.—Tobacco setter used in the Bigflats area.

Tobacco here as elsewhere is attacked by several insects that feed on the leaves, impairing the quality and lessening the yield. The grasshopper is one of the worst enemies of the tobacco, and entire fields are occasionally destroyed by this insect, though the damage is usually less severe than this, merely lessening the value of the crop.

Celery plants, like tobacco plants, are raised in hot beds or hothouses and set out in well-tilled ground as soon as the weather permits. The plants are put in by hand in rows about 3 feet apart, 15,000 or 16,000 plants being used to the acre. The fields are always kept in good tilth, and when the celery attains sufficient height it is banked for blanching. Harvesting begins the latter part of August. The plants are tied up in bunches of one dozen each, and bring about 21 cents per dozen bunches. The bulk of the crop goes to supply the local and nearby markets.

The planting, cultivating, and harvesting of the other crops are carried on here as elsewhere. The methods are too well known to need repetition.

The apple orchards, which usually consist of an acre or two around the houses, are really side issues. The crop is so uncertain that many think it unworthy of much attention. If fruit comes, well and good; if not, nothing is lost. Practically all that is done in caring for this crop is to occasionally plow the ground and prune the trees. The codling moth and forest, tent, and apple-tree caterpillars do no little damage, and, unless thorough spraying is resorted to, when there is any fruit it is badly worm-eaten.

To keep the soils in a productive state it is found necessary to fertilize them generously. Not only is all the manure produced on the farm applied annually, but this is supplemented where convenient by a large quantity hauled from nearby towns in wagons or brought in by railroad in carload lots. The latter consists largely of stock-car scrapings, etc., and is sold on the siding for $28 per car. The hauling of manure is only practiced in the valley, where it can be easily done. The hill farmers are in a great measure handicapped by the expense in getting outside manure. Their efforts should therefore be confined to increasing their home supply, first, through caring for what they have by not allowing it to leach and wash away, as it now does in many places, and, second, by increasing the number of live stock kept and selling them instead of crops.

The most manure is used on the tobacco and celery soils. On the former 30 to 60, and even 90, cubic yards are applied to an acre. The results are very apparent, and the increase in yield is said always to pay for the increased cost of fertilization. On all of the crops except tobacco one kind of manure does not seem to be much better than another, but in the case of tobacco horse manure is preferred, as it gives a lighter-colored leaf. The use of commercial fertilizers on tobacco, excepting the cotton-seed products, is seriously objected to by the buyers, for in many cases the burning properties and flavor of the leaf are so seriously impaired as to make it worthless.

Rotation is not practiced in celery production and only occasionally where tobacco is grown. Tobacco in many places has been grown from six to ten years on the same field without intermission. Occasionally, however, the lands are sown to wheat in the fall, seeded to clover in the spring, and planted to tobacco the following season with good results. Where potatoes are the main crop a two-year rotation with clover is found to be very beneficial. Where hill lands can not be fertilized or seeded to clover, which is in time replaced by timothy, the soil where turned to the plow can be farmed with good results for one or two years, but then must be put in grass and used for pasture.

The rainfall is generally sufficient for the ordinary farm crops.

There are, however, occasions when irrigation would be beneficial. In several places where lands lie adjacent to creeks the water has been diverted and used with good results. Within the area surveyed there are many farms where water could be turned upon the land at little expense, and the uncertainty of moisture supply could be eliminated from crop production.

AGRICULTURAL CONDITIONS.

The prosperity of an agricultural community depends upon the fertility of the soil and its adaptation to crops, the proximity of the region to markets and to transportation facilities, and the intelligence and energy of the people themselves. In the area covered by this survey the condition of the farmers in the valley is as a rule more prosperous than in the hills. There are, however, exceptions in both regions. Poorly kept places are found in the lowlands, due to the stony and worn-out condition of the soil or to the occupancy of an unenergetic farmer, while good farms here and there in the hills show to what extent wise husbandry and hard work can compensate for natural deficiencies in soil and location. The less thrifty appearance of the upland farms is also partly due to the fact that many more are tenanted than in the valley. Tenancy is rarely conducive to the maintenance of soil fertility or to the improvement of farm property generally.

Taking the area as a whole, the farming class is in a prosperous condition. The well-kept and well-fenced farms, improved by good and comfortable houses, and the barns and other buildings for housing the stock, covering the machinery, and curing the tobacco, attest this.

The size of the farms varies according to location. In the vicinity of the towns lands are, as a rule, more valuable and the tracts are not so large, being used more as homes than as places on which the owners are dependent for sustenance. Excluding these, 50 valley farms in the vicinity of Horseheads show an average size of 97 acres, with a valuation of about $40 per acre, while the same number of hill farms give an average of 134 acres, assessed for taxation at a little over $13 per acre. As some of the best valley lands lie outside of this district, $40 per acre can not be taken as the average value, which is probably nearer $100 per acre.

The labor of the farms is principally done by the farmers themselves, and therefore is the most efficient that could possibly be obtained. In some cases children, women, and old men all join in helping during the busy season. The hired help work practically on a basis of social equality with the proprietors, and are thus placed where they will do the most and best work. The wages paid labor ranges from $15 to $20 per month, including board, or $1 per day without board.

While tobacco is the principal crop, the average field does not exceed

4 or 5 acres, and it must not be supposed that the farmers depend entirely upon it. Their success comes from a number of sources. On all of the farms some live stock, consisting of horses, milch cows, hogs, and sheep, are kept. It is the policy to make the farm produce all the forage necessary for their maintenance, including pasturage, ensilage, hay, and grain. Dairying is carried on to a limited extent by many of the farmers, some of whom keep as many as 30 cows. The milk is sold to local creameries or to dealers who have milk stations in the cities. The average price received by the dairyman is 2 cents per quart. To obviate the necessity of each producer delivering his milk, general routes are established and a man gathers all the milk in his district and carries the cans to the station and returns empty ones on his way home.

Local truck gardens supply the town and city demands during late spring and summer, while in the country each family is furnished from the home garden. Small orchards of apples, pears, cherries, plums, and peaches, and a few grapevines are also a part of the resources of the farmer.

Good roads prevail everywhere. Even in the hill region, where the slopes are very steep and the ravines rough, they are seldom if ever impassable. The great aid they are to the successful practice of agriculture is too well known to need discussion.

Four main lines of railroad pass through the area, and with their many stations and sidings offer accommodations both in the reception and in the rapid delivery of freight to the large markets such as are enjoyed by few agricultural communities. A trolley line with a half-hour service also traverses the area from Elmira, through Horseheads and Pine Valley, to Watkins, facilitating traveling and freighting and adding much to the convenience of those along the route.

Elmira, the principal town in the area surveyed, is a growing city with a population of more than 35,000. It is the site of several colleges and has a public library and many other educational advantages. Elmira is the headquarters of a number of tobacco dealers, who buy and handle the greater portion of the tobacco raised in the area. The city is also a good market for much of the farm produce of the surrounding country.

FIG. 1.—MIAMI GRAVELLY LOAM, BIGFLATS AREA, NEW YORK.

This is one of the most gravelly soils of the Chemung Valley, but is esteemed the best tobacco soil. As with all the soils of the valley, this requires heavy annual applications of stable manure.

FIG. 2.—PEAT SOIL, ADAPTED TO CELERY, BIGFLATS AREA, NEW YORK.

These muck areas, although smaller in extent, are esteemed among the most valuable soils, being used principally for celery, onions, and cabbages.

FIELD ON ELMIRA FINE SANDY LOAM, BIGFLATS AREA, NEW YORK.

racter of the valley lands, and the steep escarpment of the Hagerstown shale loam of the upland plateau; also the substantial character of the tobacco barns of the area.

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SOIL MAP

NEW YORK
BIGFLATS SHEET

SOIL PROFILE
(3 feet deep)

Miami gravelly loam — Ssc/Gr; Ssc/Gr

Hagerstown shale loam — Sc/St; Sc/St

Elmira fine sandy loam — Ssc/f; Ssc

Elmira shale loam — Sc; Sc/St

Elmira silt loam — Sic; Sicc

Peat — P

Meadow — Scc; S

LEGEND

Ssc/Gr	Sandy loam and gravel
Sc/St	Loam and stone
Ssc/f	Fine sandy loam
Scc	Clay loam
Ssc	Sandy loam
Sic	Silt loam
Sc	Loam
Sicc	Heavy silt loam
S	Sand
P	Peat

LEGEND

Mgl — Miami gravelly loam

Hs — Hagerstown shale loam

Efs — Elmira fine sandy loam

Es — Elmira shale loam

Esl — Elmira silt loam

P — Peat

M — Meadow

Very gravelly Areas

Soils Surveyed by
Louis Mesmer
and W E Hearn
1902

BASE MAP FROM
U S GEOLOGICAL SURVEY
Reprint 1898

Scale 1/62,500
1 ½ 0 1 2 3 4 Miles

Contour Interval 20 feet
Datum is mean Sea level

A Hoen & Co Lith Baltimore Md.

Field Operations
Bureau of Soils
1902